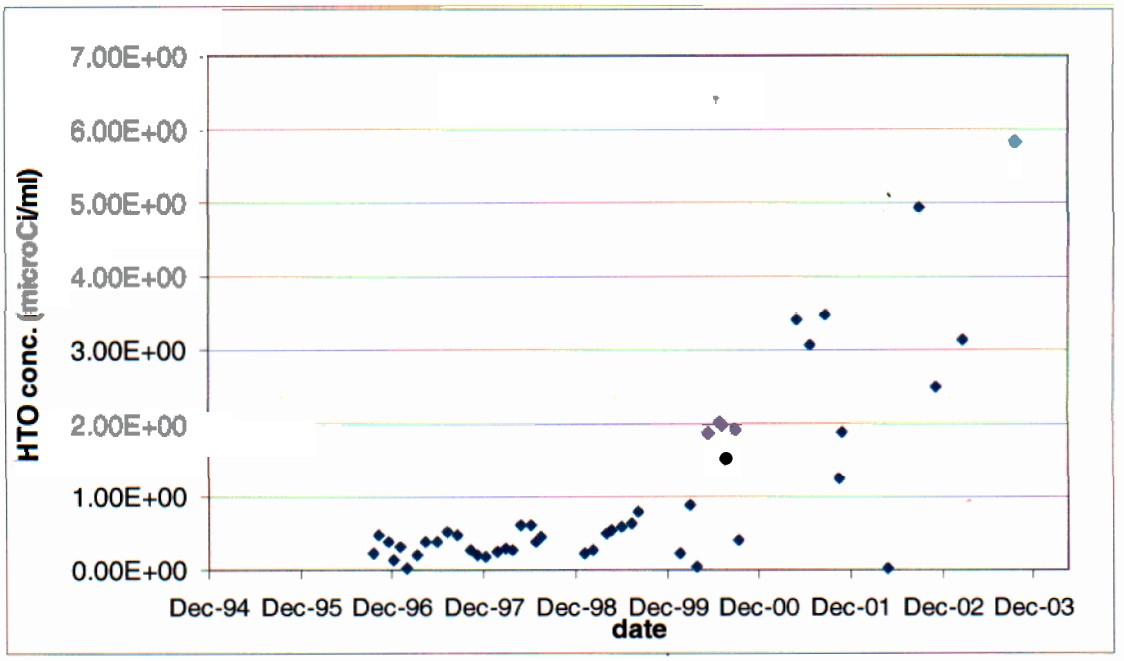

Figure 3-19. Tritium concentration in water vapor from the 20.3-ft-deep GSP-1 soil-gas sampling port.

3.4.2.1 Lysimeter Samples at Depths of 0 to 35 ft. Seven tritium analyses were performed on soil-moisture samples collected from six shallow lysimeters in and around the SDA in FY 2003, with one positive detection (see Table 3-12). Results for tritium in the shallow vadose-zone samples, since routine monitoring began in 1997, are summarized in Figure 3-20. Sporadic detections occur, but no apparent trends for tritium are exhibited in the shallow lysimeters, except for W06:DL27 (see Figure 3-21). Concentrations in this lysimeter had increased from FY 1997 through 1999, but no samples have been collected since then (see Table 3-15). The closest known source of H-3, relative to the location of W06-L27, is the activated beryllium at SVR 20, which is approximately 48 m (150 ft) to the east. Tritium also was detected in Lysimeter PA02-L16 at 2.7 m (8.7 ft) deep from 1997 through 1998. The "T" and "O" series wells were installed between November 1999 and March 2000, and the first samples were collected in June 2000. Unfortunately, conditions at W06 are apparently very dry due to several years of below-average precipitation, and very limited sample volume has been extracted. No samples have been analyzed for H-3 from that well since 2000, so it is not possible to assess current trends in that well.

Table 3-12. Tritium detections in Fiscal Year 2003 Subsurface Disposal Area vadose zone soil-moisture samples from the 0- to 35-ft depth interval.

Lysimeter	Depth (ft)	Sample Dat	Sample Result ± 1σ (pCi/L)	MDA (pCi/L)	Local Soil-Moisture Background[a] (pCi/L)	Aquifer RBC[b] (pCi/L)
PA02-L16	8.7	07/21/03	**368 ± 77**[c]		Nondetect	9392

a. The local soil-moisture background concentration for tritium is defined as a nondetect (i.e., a result less than or equal to its MDA and less than or equal to three times its reported 1σ uncertainty).
b. RBC = 1E-05 for drinking water. The RBCs for the aquifer are provided here as a basis of comparison.
c. **Black bold font** indicates sample concentrations less than the RBC, but exceeding local soil-moisture background concentrations (see footnote a).
MDA = minimum detectable activity
RBC = risk-based concentration
SDA = Subsurface Disposal Area

		Tritium RWMC Lysimeters (0–35 ft)															
FY	Qtr	98-1 L35	98-4 L38	98-5 L39	D15-DL07	PA01-L15	PA02-L16	PA03-L33	W05-L25	W06-L27	W08-L13	W08-L14	W09-L23	W23-L07	W23-L08	W23-L09	W25-L28
1997	1																
	2																
	3						243			2510		129				154	366
	4						167			3270	1140						235
1998	1																
	2																
	3						328										
	4					991				7290					383		
1999	1						1380			8650							
	2																
	3																
	4																
2000	1									9100							
	2																
	3									9070	815						
	4																
2001	1																
	2																
	3																
	4																
2002	1																
	2																
	3																
	4																
2003	1													187			
	2																
	3																
	4						368										
Key		Analysis was performed, but tritium was not detected.															
		Tritium was detected (pCi/L).															
		If more than one positive detection occurred in a single quarter, then only the highest concentration is listed. Note: RBC = 9,392 pCi/L FY = fiscal year RBC = 1E-05 risk-based concentration RWMC = Radioactive Waste Management Complex															

Figure 3-20. Occurrences of tritium detections in the shallow lysimeters since Fiscal Year 1997.

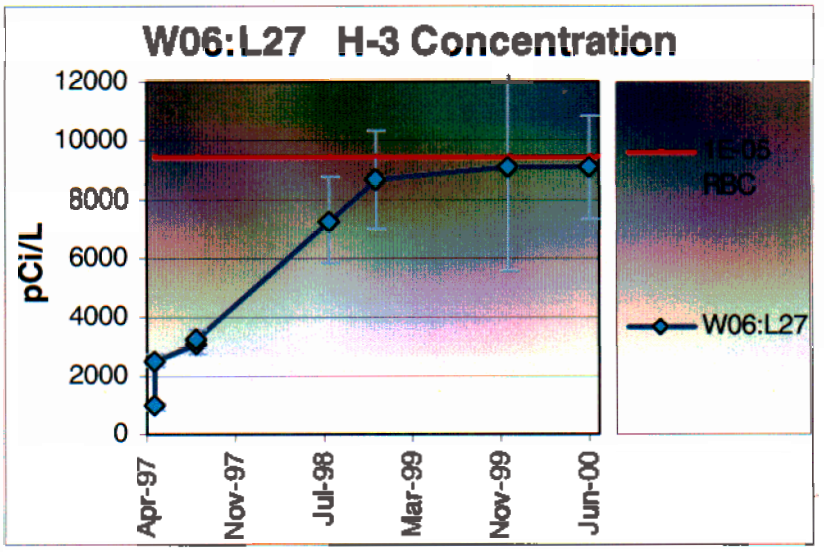

Figure 3-21. Tritium concentration history for Lysimeter W06:L27 from April 1997 to June 2000.

3.4.2.2 Lysimeter Samples at Depths of 35 to 140 ft. Eleven tritium analyses were performed on soil-moisture samples collected from 11 intermediate-depth lysimeters in and around the SDA in FY 2003, with four positive detections (see Table 3-13). Results for the intermediate vadose zone samples, since routine monitoring began in 1997, are summarized in Figure 3-22. There are sporadic detections, but no apparent increasing trends for tritium in the intermediate-depth lysimeters. Tritium is consistently detected in an intermediate-depth lysimeter (TW1-DL04) at about 31 m (102 ft) deep, but there is no apparent trend (see Figure 3-23).

Table 3-13. Tritium detections in Fiscal Year 2003 Subsurface Disposal Area vadose zone soil-moisture samples from the 35- to 140-ft depth interval.

Lysimeter	Depth (ft)	Sample Date	Sample Result ± 1σ (pCi/L)	MDA (pCi/L)	Local Soil-Moisture Background[a] (pCi/L)	Aquifer RBC[b] (pCi/L)
O4S:DL24	108.5	07/10/03	**228 ± 70**	223	Nondetect	9392
I2S:DL11	92	07/21/03	**580 ± 85**	242	Nondetect	9392
TW1:DL04	101.7	07/21/03	**1,690 ± 178**	476	Nondetect	9392
I1S:DL09	101	07/22/03	**277 ± 69**	217	Nondetect	9392

a. The local soil-moisture background concentration for tritium is defined as a nondetect (i.e., a result less than or equal to its MDA and less than or equal to three times its reported 1σ uncertainty).
b. RBC = 1E-05 for drinking water. The RBCs for the aquifer are provided here as a basis of comparison.
c. **Black bold font** indicates sample concentrations less than the RBC, but exceeding local soil-moisture background concentrations (see footnote a).
MDA = minimum detectable activity
RBC = risk-based concentration
SDA = Subsurface Disposal Area

		Tritium RWMC Lysimeters (35–140 ft)													
FY	Qtr	D06-DL01	D06-DL02	D15-DL06	I1S-DL09	I2S-DL11	I3S-DL13	I4S-DL15	I5S-DL16	O2S-DL20	O3S-DL22	O4S-DL24	O5S-DL25	O7S-DL28	TW1-DL04
1997	1														
	2														
	3														
	4														
1998	1														
	2														
	3														2520
	4														1680
1999	1														2950
	2														
	3														
	4														
2000	1														
	2														
	3														
	4														
2001	1														
	2														
	3														
	4														
2002	1														
	2														
	3														
	4														
2003	1														
	2														
	3														
	4				277	580						228			1690
Key		Analysis was performed, but tritium was not detected.													
		Tritium was detected (pCi/L).													
		If more than one positive detection occurred in a single quarter, then only the highest concentration is listed. Note: RBC = 9,392 pCi/L FY = fiscal year RBC = 1E-05 risk-based concentration RWMC = Radioactive Waste Management Complex													

Figure 3-22. Occurrences of tritium detections in intermediate-depth (35- to 140-ft) lysimeters since Fiscal Year 1997.

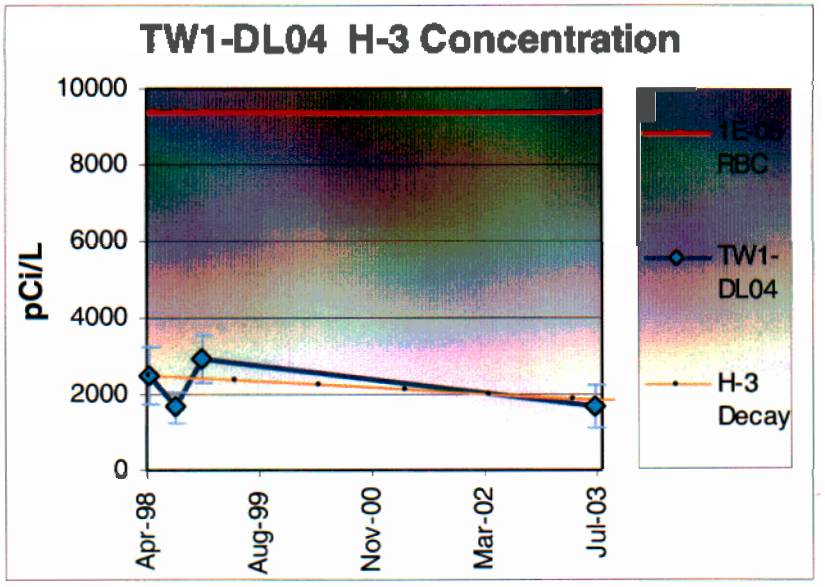

Figure 3-23. Tritium concentration history for Lysimeter TW1:DL04.

3.4.2.3 Lysimeter Samples at Depths Greater than 140 ft. One tritium analysis was performed on a deep-suction lysimeter sample collected outside the SDA in FY 2003, with no positive detection. Results for the samples, since routine monitoring began in 1997, are summarized in Figure 3-24. The "I" and "O" series wells were installed between November 1999 and March 2000, and the first samples were collected in June 2000. Tritium is frequently detected in the USGS-92 perched water well at concentrations slightly above the method detection limits, with no observable trend.

		Tritium RWMC Perched Water and Lysimeters (>140 ft)									
FY	Qtr	8802D	USGS-092	I2D-DL10	I3D-DL12	I4D-DL14	O2-DL19	O4-DL23	O6-DL26	O7-DL27	O8-DL29
1997	1										
	2										
	3		310								
	4		196								
1998	1										
	2		314								
	3										
	4										
1999	1		1570								
	2										
	3										
	4										
2000	1										
	2										
	3										
	4										
2001	1										
	2										
	3										
	4										
2002	1										
	2										
	3										
	4										
2003	1										
	2										
	3										
	4										

Key	
	Analysis was performed for tritium, but none was detected.
	[illegible]
	[illegible] listed. FY = fiscal year RWMC = Radioactive Waste Management Complex USGS = United States Geological Survey

3.4.3 Aquifer

Sixty-four H-3 analyses were performed on aquifer samples collected from 15 monitoring wells in the vicinity of the RWMC in FY 2003, with 26 positive detections above aquifer background levels but significantly below the drinking water MCL (see Table 3-14). Detections of H-3 in aquifer samples occur regularly in Wells M3S, M7S, M12S, M14S, M16S, and M17S (see Figure 3-25) and have never occurred

in Wells M1S, M4D, M6S, M10S, M112, M13S, M15S, or USGS-127. The occurrence of H-3 detections since 1997 are summarized in Figure 3-25. Tritium detections above background have been isolated to the northeastern part of the SDA; however, in FY 2003, H-3 was detected at low concentrations in two wells south of the SDA. The two wells, OW-2 and A11A31, are located approximately 1.0 and 1.5 mi south of the SDA, respectively. Subsequent samples collected from these two monitoring wells have not shown positive detections for H-3.

Table 3-14. Tritium detected above aquifer background concentrations.

Well	Sample Date	Radionuclide	Sample Result ± 1σ (pCi/L)	MDA (pCi/L)	Aquifer Background[a] (pCi/L)	MCL[b] (pCi/L)
M3S	11/05/02	H-3	**1,220 ± 104**[c]	278	0–40	20,000
	02/05/03	H-3	**1,390 ± 122**[c]	321	0–40	20,000
	05/06/03	H-3	**1,380 ± 107**[c]	280	0–40	20,000
	08/06/03	H-3	**1320 ± 152**[c]	363	0–40	20,000
M7S	11/12/02	H-3	**1,190 ± 102**[c]	283	0–40	20,000
	02/03/03	H-3	**1,320 ± 123c**	331	0–40	20,000
	04/29/03	H-3	**877 ± 101**[c]	288	0–40	20,000
	08/05/03	H-3	**1210 ± 144**[c]	347	0–40	20,000
M12S	11/05/02	H-3	**1,390 ± 107**[c]	278	0–40	20,000
	02/03/03	H-3	**1,600 ± 129**[c]	325	0–40	20,000
	04/29/03	H-3	**1,010 ± 102**[c]	285	0–40	20,000
	08/04/03	H-3	**1260 ± 157**[c]	388	0–40	20,000
M14S	11/05/02	H-3	**1,690 ± 121**[c]	307	0–40	20,000
	02/03/03	H-3	**1,680 ± 97**[c]	222	0–40	20,000
	04/28/03	H-3	**1,500 ± 110**[c]	283	0–40	20,000
	08/05/03	H-3	**1500 ± 158**[c]	366	0–40	20,000
M16S	11/11/02	H-3	**901 ± 99**[c]	287	0–40	20,000
	02/04/03	H-3	**871 ± 106**[c]	311	0–40	20,000
	04/30/03	H-3	**823 ± 100**[c]	289	0–40	20,000
	08/04/03	H-3	**743 ± 134**[c]	369	0–40	20,000
M17S	11/06/02	H-3	**871 ± 106**[c]	305	0–40	20,000
	11/06/02	H-3	**752 ± 105**[c]	307	0–40	20,000
	02/03/03	H-3	**770 ± 106**[c]	324	0–40	20,000
	05/07/03	H-3	**521 ± 94**[c]	285	0–40	20,000
	08/06/03	H-3	**686 ± 132**[c]	369	0–40	20,000
A11A31	08/04/03	H-3	**624 ± 129**[c]	366	0–40	20,000
OW-2	11/11/02	H-3	**300 ± 90**[c]	288	0–40	20,000

a. The USGS established the SRPA background ranges in 1992 from samples collected upgradient (i.e., Mud Lake area) and downgradient (i.e., Magic Valley area) of the INEEL (Knobel, Orr, and Cecil 1992).
b. The MCLs are from the "National Primary Drinking Water Regulations" (40 CFR 141) established by the U.S. Environmental Protection Agency.
c. **Black bold font** indicates sample concentrations less than the MCL, but exceeding aquifer background concentrations (see footnote a).
CFR = *Code of Federal Regulations*
INEEL = Idaho National Engineering and Environmental Laboratory
MCL = maximum contaminant level
MDA = minimum detectable activity
SRPA = Snake River Plain Aquifer
USGS = United States Geological Survey

Tritium RWMC Aquifer-Monitoring Wells																		
FY	Qtr	A11-A31	M10S	M11S	M12S	M13S	M14S	M15S	M16S	M17S	M1S	M3S	M4D	M6S	M7S	OW2	RWMC Prod	USGS -127
1997	1																	
	2																1,490	
	3											1,910			1,430		1,320	
	4																	
1998	1											1,540			1,250		1,230	
	2																1,130	
	3											1,770			1,370			
	4				1,990		1,670					1,920			1,440		1,550	
1999	1				1,610		1,860					1,410			1,260		1,600	
	2				1,360		1,870					1,710			1,400		1,500	
	3				1,570		1,710					1,600			1,400		1,600	
	4				1,390		1,740					1,700			1,420		1,500	
2000	1				1,660		1,520					1,470			1,150		1,600	
	2				1,500		1,860		1,020			1,690			1,440		1,290	
	3									836							1,140	
	4				1,370		1,640		1,480	1,010		1,760			1,250		1,500	
2001	1						1,730		1,040	613		1,360			1,150		1,040	
	2				776		889					915			802			
	3				1,480		1,470		809	533		1,270			1,110			
	4				1,640		1,520		1,170	837		1,680			1,240			
2002	1				1,120		1,240		847	507		1,260			951			
	2				1,190		1,740		1,210	678		1,600			1,450			
	3				1,620		1,790		1,250	1,110		1,320			1,120			
	4				1,380		1,600		946	608		1,090			1,020			
2003	1				1,390		1,690		901	871		1,220			1,190	300		
	2				1,600		1,680		871	770		1,390			1,320			
	3				1,010		1,500		823	521		1,380			877			
	4	624			1,260		1,500		743	686		1,320			1,210			

Key	
	Analysis was performed, but tritium was not detected.
	Tritium was detected (pCi/L).
	If more than one positive detection occurred in a single quarter, then only the highest concentration is listed. Note: MCL = 20,000 pCi/L FY = fiscal year MCL = maximum contaminant level RWMC = Radioactive Waste Management Complex USGS = United States Geological Survey

Figure 3-25. Occurrences of tritium detections in the aquifer since Fiscal Year 1997.

3.4.4 Summary of Tritium

Tritium is not a contaminant of potential concern; however, it is present in the SDA vadose zone and aquifer. In addition, a substantial fraction of H-3 released from waste migrates to the atmosphere. Tritium concentration in air above SVR 20 ranges over several orders of magnitude during the year, with peak concentrations occurring in late summer. There is an obvious trend of increasing tritium concentrations over time in soil vapor samples collected near the buried beryllium blocks near SVR 20. Elevated H-3 concentrations were detected in the air samples collected above the beryllium block disposals; however, trends are not evident. Estimated emissions of H-3 from buried activated beryllium at SVR 20 for CY 2003 were about 5 Ci. These data are used to develop emission estimates by calendar year for all disposed beryllium as required by 40 CFR 61, Subpart H.

Tritium was detected in several lysimeters located in and around Pad A and Pit 5 areas, and it was detected in some of these lysimeters in 1998 and 2000. Adequate volume for H-3 analyses was obtained for the first time from samples on the western end of the SDA ("T" and "O" wells), and low levels of H-3 were detected. Some of the measured concentrations are near the detection sensitivities of about 300–400 pCi/L; thus, it will require a few more sampling events to establish a sense of potential H-3 trends in these monitoring wells. The samples from Wells PA01 and W25 have relatively high H-3 concentrations of 10,200 pCi/L and 3,680 pCi/L, respectively. These relatively high concentrations are unexpected, since these wells have no previous history of recurrent H-3 detections. Further sampling of PA01 and W25, as well as the other wells, is necessary to substantiate the actual concentration of H-3 in these monitoring wells.

In the aquifer beneath the RWMC, H-3 is consistently measured in six monitoring wells and is consistently absent in the other wells. Tritium concentrations in these six wells are gradually decreasing, and the decrease appears to correlate with the calculated rate of radioactive decay (see Figure 3-26, M7S example); however, it does not correlate with expected influences from dilution and dispersion. Under normal conditions, an initial pulse of H-3 decayed, dispersed, and diffused over time would decrease much more rapidly (see Figure 3-26, USGS-65 example). It could be that H-3 is being added to the aquifer at a rate that exceeds decay effects. Tritium is not detected downgradient of the RWMC, and the general pattern of H-3 occurrence around RWMC area wells is not yet understood.

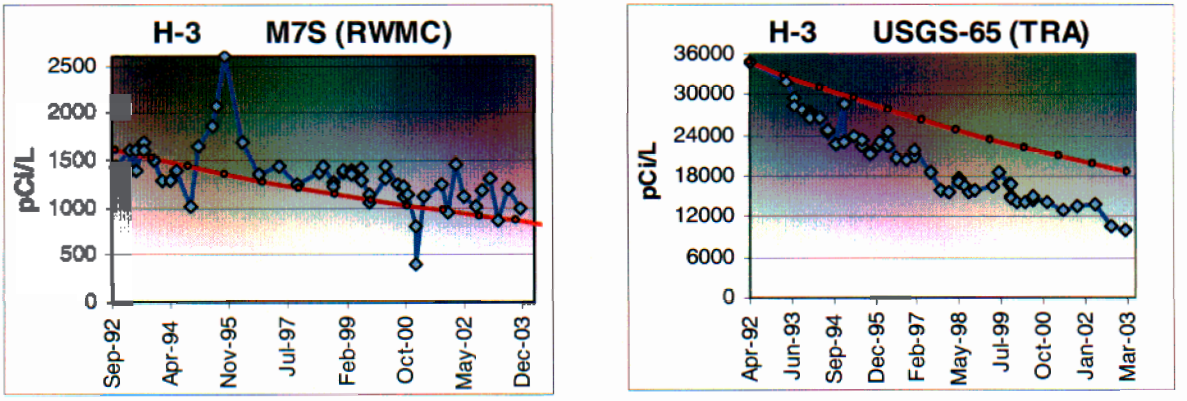

Figure 3-26. Comparison of tritium concentration time histories showing the observed effects of radioactive decay (•) and dilution and dispersion (Test Reactor Area well); and the observed effects of radioactive decay (•) with no apparent dilution and dispersion (Radioactive Waste Management Complex well).

The clear pattern of H-3 detections and nondetections in RWMC area wells suggests that H-3 might be a good modeling calibration target; however, the source term is difficult to define. Tritium has been injected into the aquifer at the Test Reactor Area (TRA) and INTEC, and tritium has migrated through both the vapor phase and infiltrating waters in the vadose zone at the SDA. Quantifying and tracking these varied inputs, while also accounting for complex source-release rates and adjusting for decay, could result in large uncertainties that diminish the effort. A study to determine the impact of upgradient facilities on the aquifer at the RWMC was conducted in the spring and summer of 2003. It was determined that the source of tritium detected in wells on the north side of the RWMC could be the TRA, and tritium detected on the east side of the RWMC could be from INTEC and/or TRA. However, there still exists a possibility that some tritium is from the SDA. Additional information is needed to reach a conclusion about the source(s) of tritium in the RWMC aquifer. Maximum concentrations of H-3 in vadose zone soil moisture and perched water since October 2002 are shown in Table 3-15. Maximum concentrations of H-3 in the RWMC aquifer since October 2002 are shown in Table 3-16.

Table 3-15. Summary of maximum concentrations of tritium in vadose zone soil-moisture and perched water samples at the Radioactive Waste Management Complex from Fiscal Year 1997 through 2003.[a]

Sampling Range (feet below land surface)	Fiscal Year[b]	Maximum Concentration ± 1σ (pCi/L)[c]	Sample Location
Lysimeters 0 to 35 ft	1997	3270 ± 100	W06-L27
	1998	7290 ± 474	W06-L27
	1999	8650 ± 554	W06-L27
	2000	**9100 ± 1180**	W06-L27
	2001	NA	—
	2002	NA	—
	2003	368 ± 77	PA02-L16
Lysimeters 35 to 140 ft	1997	NA	—
	1998	2520 ± 249	TW1-DL04
	1999	NA	—
	2000	NA	—
	2001	NA	—
	2002	NA	—
	2003	1690 ± 178	TW1-DL04
Lysimeters >140 ft	1997	NA	—
	1998	NA	—
	1999	NA	—
	2000	NA	—
	2001	NA	—
	2002	NA	—
	2003	ND	O7D-DL27, DE-06

Table 3-15. (continued).

Sampling Range (feet below land surface)	Fiscal Year [b]	Maximum Concentration ± 1σ (pCi/L)[c]	Sample Location
Perched water wells >140 ft	1997	ND	USGS-92
	1998	310 ± 35	USGS-92
	1999	1570 ± 188	USGS-92
	2000	ND	USGS-92
	2001	NA	—
	2002	NA	—
	2003	ND	USGS-92

a. MCL = 20,000 pCi/L
b. Fiscal year spans from October 1 to September (e.g., Fiscal Year 1997 is October 1, 1996, to September 30, 1997).
c. NA = not analyzed ND = not detected
MCL = maximum contaminant level
USGS = United States Geological Survey

Table 3-16. Summary of maximum concentrations of tritium in aquifer wells at the Radioactive Waste Management Complex from Fiscal Year 1997 through 2003.[a]

Fiscal Year [b]	Maximum Concentration ± 1σ (pCi/L)	Well Location
1997	1910 ± 182	M3S
1998	1990 ± 270	M12S
1999	1860 ± 247	M14S
2000	1860 ± 177	M14S
2001	1730 ± 192	M14S
2002	1740 ± 148	M14S
2003	1690 ± 121	M14S

a. MCL = 20,000 pCi/L
b. Fiscal year spans from October 1 to September 30 (e.g., Fiscal Year 1997 is October 1, 1996, to September 30, 1997).
MCL = maximum contaminant level

3.5 Iodine-129

Iodine-129 is produced from nuclear reactor operations and weapons testing, and it occurs naturally in the environment through interactions of cosmic rays with atmospheric gases and from the spontaneous fission of U-238. Approximately 0.15 Ci of I-129 was disposed of in the SDA, primarily from INEEL reactor operations waste.

3.5.1 Waste Zone

Approximately 10 mL of soil moisture was collected from Waste-Zone Lysimeter 741-08-L1 on September 8, 2003, but the volume was not sufficient to analyze for I-129; however, the sample was analyzed for gamma-emitting radionuclides with no positive detections.

3.5.2 Vadose Zone

3.5.2.1 Lysimeter Samples at Depths from 0 to 35 ft. Three I-129 analyses were performed on soil-moisture samples collected from three shallow lysimeters in and around the SDA in FY 2003, with no positive detections. Occurrences of I-129 detections in the shallow vadose-zone samples, since routine monitoring began in 1997, are summarized in Figure 3-27.

		Iodine-129 RWMC Lysimeters (0–35 ft)															
FY	Qtr	98-1 L35	98-4 L38	98-5 L39	D15-DL07	PA01-L15	PA02-L16	PA03-L33	W05-L25	W06-L27	W08-L13	W08-L14	W09-L23	W23-L07	W23-L08	W23-L09	W25-L28
1997	1																
	2																
	3																
	4																
1998	1																
	2																
	3																
	4																
1999	1	53		29													
	2																
	3																
	4																
2000	1																
	2																
	3																22
	4																
2001	1																
	2																
	3																
	4																
2002	1																
	2																
	3																
	4																
2003	1																
	2																
	3																
	4																

Key	
	Analysis was performed, but iodine-129 was not detected.
	Iodine-129 was detected (pCi/L).
	If more than one positive detection occurred in a single quarter, then only the highest concentration is listed. Note: RBC = 3.22 pCi/L FY = fiscal year RBC = 1E-05 risk-based concentration RWMC = Radioactive Waste Management Complex

Figure 3-27. Occurrences of iodine-129 detections in shallow lysimeter wells.

Since monitoring began, only three positive results have been observed in soil-moisture samples collected from the vadose zone. There is a concern about why there are so few I-129 detections in soil-moisture samples. The process to sample soil moisture (i.e., vacuum) could cause a significant portion of I-129 to volatilize from the water sample, thereby reducing the concentrations to a level that cannot be measured by routine analytical methods.

3.5.2.2 Lysimeter Samples from 35 to 140 ft Deep. Four I-129 analyses were performed on soil-moisture samples collected from four intermediate-depth lysimeters in and around the SDA in FY 2003, with no positive detections. Two samples were collected in October 2002 from Lysimeters D15-DL06 and O5-DL25. One sample was collected in January 2003 from Lysimeter I1S-DL09. One sample was collected in July 2003 from Lysimeter O4-DL24. No Np-237 has been detected in shallow lysimeter samples since monitoring began in FY 2000; therefore, a figure showing occurrences is not presented.

3.5.2.3 Lysimeter and Perched Water Samples at Depths Greater than 140 ft. One perched water sample and no soil-moisture samples were obtained at a range deeper than 140 ft and analyzed for I-129 in FY 2003, resulting in no positive detections. The perched water sample was collected from USGS-92 in October 2002. No I-129 has been detected in any wells or lysimeters from this depth range since sample collection began in 1997; therefore, a figure showing occurrences is not presented.

3.5.3 Aquifer

Seventy-eight I-129 analyses were performed on aquifer samples collected from 15 monitoring wells in the vicinity of the RWMC in FY 2003, with one detection (Well M13S). The detection did not meet the criteria of a positive detection, since its result (0.7±0.2 pCi/L) was less than the MDA (0.8 pCi/L). Therefore, the project assigned a "J" data qualifier flag to the result to indicate it was not a valid detection. In addition, an I-129 result from a separate sample collected from M13S in conjunction with this sample, but for another purpose, was a nondetect. Iodine-129 has not been detected in any aquifer wells since 1999 (Figure 3-28).

A special sampling and analysis event, outside the scope of routine WAG 7 aquifer monitoring, was conducted in April and May 2003. The special study assessed possible impacts to the aquifer at the RWMC from upgradient facilities and included analysis of I-129 at detection sensitivities less than or equal to 0.1 pCi/L, which is 10 times lower than the standard method detection limit of 1 pCi/L. Fourteen RWMC aquifer wells were sampled and none of the aquifer samples tested positive for I-129 at these low concentrations. The samples were collected from Wells AllA31, M1S, M3S, M4D, M6S, M7S, M12S, M13S, M14S, M15S, M16S, M17S, OW2, and USGS-127.

3.5.4 Summary of Iodine-129

No I-129 was detected in soil-moisture samples collected in FY 2003 from the SDA vadose zone or from water samples collected from RWMC aquifer-monitoring wells. Historical detections in the vadose zone and perched water are sporadic and not indicative of trends. Figure 3-29 depicts historical I-129 detections with the known I-129 disposal locations. The detection of I-129 in soil moisture from Lysimeter 98-1L35, at a depth of 5 m (16.5 ft), is the only detection that occurred near a mapped disposal location. The three lone detections depicted in Figure 3-27 were not substantiated in later sampling events. Tables 3-17 and 3-18 summarize the maximum I-129 concentrations detected in vadose zone and aquifer samples since FY 1997, respectively. Detections are sporadic and not indicative of trends or widespread contamination. The absence of I-129 in the aquifer around the RWMC, as determined by the special study conducted in May 2003, provides evidence that I-129 is not present in the SRPA in or around the RWMC.

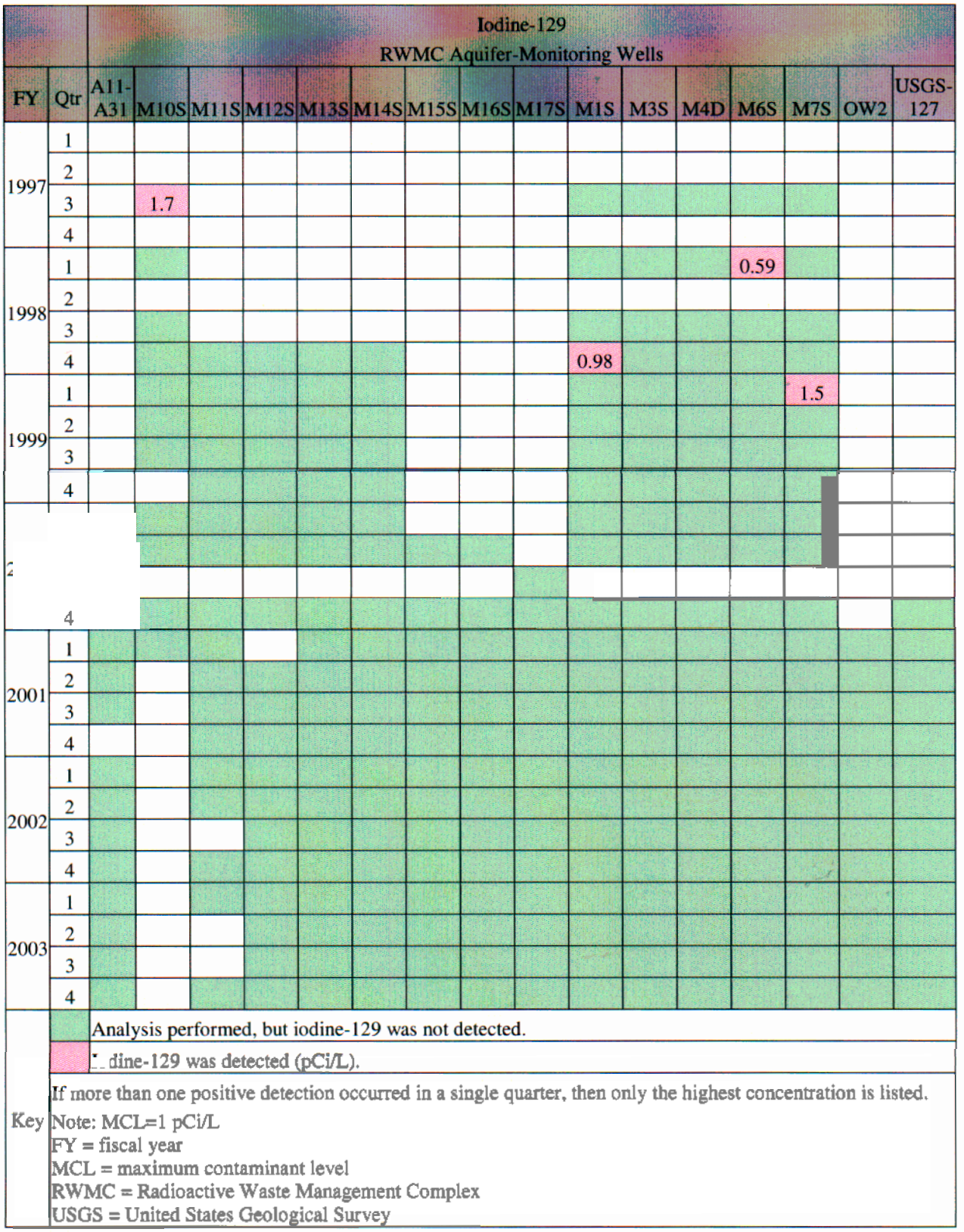

Figure 3-28. Occurrences of iodine-129 detections in Radioactive Waste Management Complex aquifer wells.

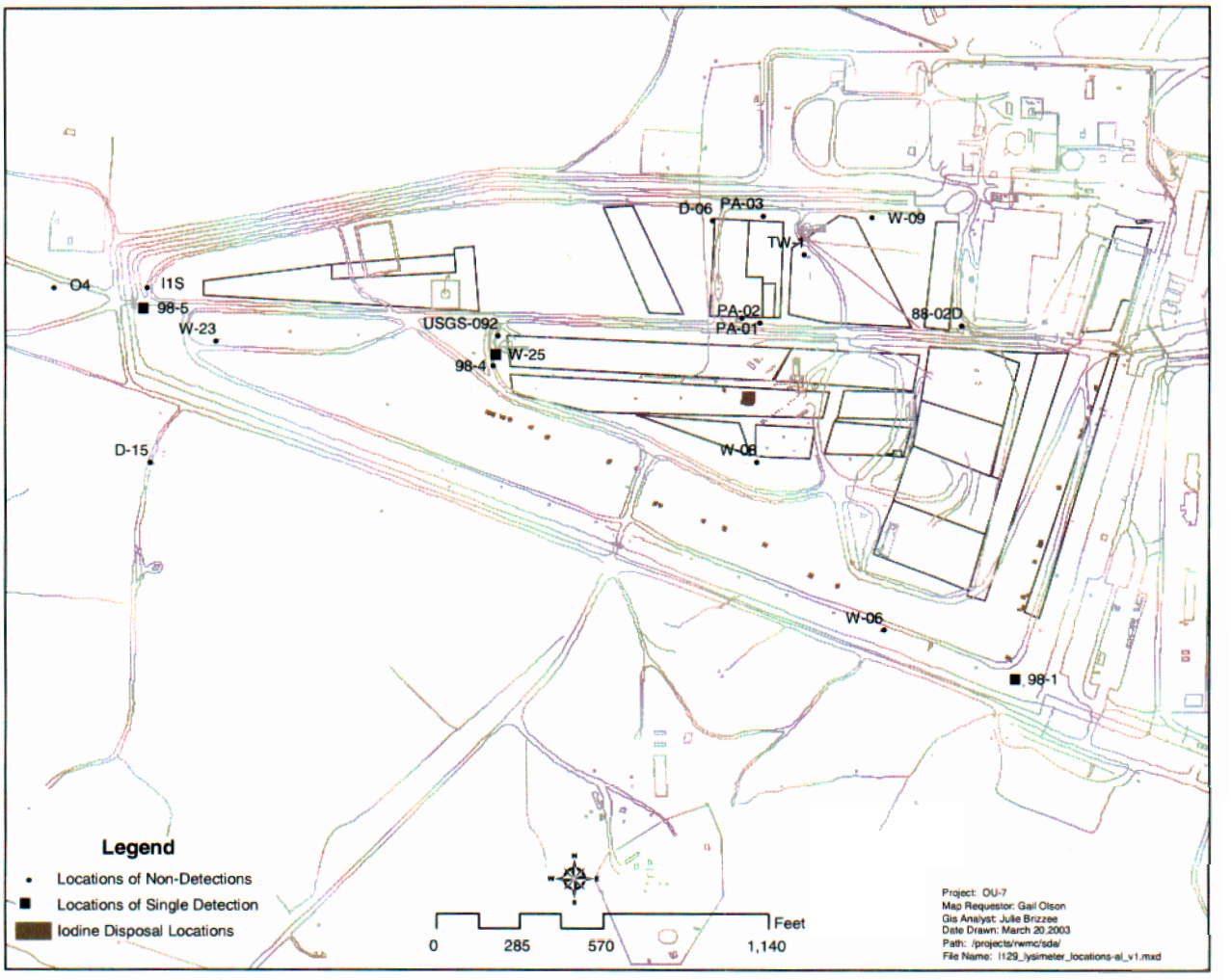

Figure 3-29. Iodine-129 disposal locations and vadose zone detection locations at the Subsurface Disposal Area.

Table 3-17. Summary of maximum concentrations of iodine-129 in vadose zone soil-moisture and perched water samples at the Radioactive Waste Management Complex from Fiscal Year 1997 through 2003.[a]

Sampling Range (feet below land surface)	Fiscal Year[b]	Maximum Concentration ± 1σ (pCi/L)[c]	Sample Location
Lysimeters 0 to 35 ft	1997	ND	Various[d]
	1998	ND	Various
	1999	53 ± 18	**98-1L35**
	2000	22 ± 7	**W25-L28**
	2001	NA	—
	2002	NA	—
	2003	ND	Various
Lysimeters 35 to 140 ft	1997	ND	D06-DL02
	1998	ND	Various
	1999	NA	—
	2000	NA	—
	2001	NA	—
	2002	NA	—
	2003	ND	Various
Lysimeters >140 ft	1997	NA	—
	1998	NA	—
	1999	NA	—
	2000	NA	—
	2001	NA	—
	2002	NA	—
	2003	ND	DE-06
Perched water wells >140 ft	1997	ND	USGS-92
	1998	ND	8802D
	1999	ND	USGS-92
	2000	NA	—
	2001	NA	—
	2002	ND	USGS-92
	2003	ND	USGS-92

a. MCL = 1 pCi/L
b. Fiscal year spans from October 1 to September 30 (e.g., Fiscal Year 1997 is October 1, 1996, to September 30, 1997).
c. NA = not analyzed **ND = not detected**
d. Various locations were sampled.
MCL = maximum contaminant level
USGS = United States Geological Survey

Table 3-18. Summary of maximum concentrations of iodine-129 in aquifer wells at the Radioactive Waste Management Complex from Fiscal Year 1997 through 2003.[a]

Fiscal Year[b]	Maximum Concentration ± 1σ (pCi/L)	Well Location
1997	1.7 ± 0.4	M10S
1998	1.0 ± 0.2	M1S
1999	1.5 ± 0.4	M7S
2000	ND[c]	Various[d]
2001	ND[c]	Various[d]
2002	ND[c]	Various[d]
2003	ND	Various[d]

a. MCL = 1 pCi/L
b. Fiscal year spans from October 1 to September 30 (e.g., Fiscal Year 1997 is October 1, 1996, to September 30, 1997).
c. ND = not detected
d. Various locations were sampled.
MCL = maximum contaminant level

3.6 Neptunium-237

Neptunium-237 is a transuranic (TRU) isotope that is a product of nuclear reactor operations and is a decay product of Am-241. Approximately 2.6 Ci of Np-237 was disposed of in the SDA, and approximately 37 Ci of Np-237 is expected to be produced over time from the radioactive decay of Pu-241.

3.6.1 Waste Zone

Approximately 10 mL of soil moisture was collected from Waste-Zone Lysimeter 741-08-L1 on September 8, 2003, but the volume was not sufficient to analyze for Np-237; however, the sample was analyzed for gamma-emitting radionuclides with no positive detections. Historically, Np-237 has been detected in soil moisture from Waste-Zone Lysimeter 741-08-L1 in April 2002.

3.6.2 Vadose Zone

3.6.2.1 Lysimeter Samples from 0 to 35 ft Deep. Ten Np-237 analyses were performed on soil-moisture samples collected from eight shallow lysimeters in and around the SDA in FY 2003, with no positive detections. Five samples were collected in October 2002 from Lysimeters W08-L13, W23-L07, W25-L28, 98-4L38, and 98-5L39. One sample was collected in January 2003 from Lysimeter W25-L28. Four samples were collected in July 2003 from Lysimeters PA01-L15, PA02-L16, W23-L07, and W23-L09. No Np-237 has been detected in shallow lysimeter samples since monitoring began in FY 2000; therefore, a figure showing occurrences is not presented.

3.6.2.2 Lysimeter Samples from 35 to 140 ft Deep. Twenty-three Np-237 analyses were performed on soil-moisture samples collected from 12 intermediate-depth lysimeters in and around the SDA in FY 2003, with no positive detections. Eight samples were collected in October 2002 from Lysimeters D15-DL06, I1S-DL09, I2S-DL11, I3S-DL13, I4S-DL15, O5-DL25, O7-DL28, and TW1-DL04. Seven samples were collected in January 2003 from Lysimeters I1S-DL09, I2S-DL11, I3S-DL13, O3-DL22, O4-DL24, O5-DL25, and O7-DL28. Eight samples were collected in July 2003 from Lysimeters D06-DL01, D15-DL06, I1S-DL09, I2S-DL11, I4S-DL15, O2-DL20, O4-DL24, and

O7-DL28. No Np-237 has been detected in intermediate-depth lysimeter samples since monitoring began in FY 2000; therefore, a figure showing occurrences is not presented.

3.6.2.3 Lysimeter and Perched Water Samples Deeper than 140 ft. Twelve Np-237 analyses were performed on samples collected from five lysimeters and two perched water wells in and around the SDA in FY 2003, with no positive detections. The perched water samples were collected from 8802D and USGS-92 in October 2002 and January 2003. Five samples were collected in October 2002 from Lysimeters I3D-DL12, I4D-DL14, O2-DL19, O4-DL23, and O7-DL27. Three samples were collected in January 2003 from Lysimeters I3D-DL12, I4D-DL14, O2-DL19, and O4-DL23. No Np-237 has been detected in any samples collected at this depth since monitoring began; therefore, a figure showing occurrences is not presented.

3.6.3 Aquifer

Sixty-three Np-237 analyses were performed on aquifer samples collected from 15 monitoring wells in the vicinity of the RWMC in FY 2003, with no positive detections. Samples were collected in November 2002 and February, April, May, and August 2003 from Monitoring Wells AllA31, M1S, M3S, M4D, M6S, M7S, M11S, M12S, M13S, M14S, M15S, M16S, M17S, OW2, and USGS-127. Other than three low-level, unconfirmed detections last fiscal year, no Np-237 has been detected in RWMC monitoring wells since monitoring for Np-237 began in FY 1999; therefore, a figure showing occurrences is not presented.

3.6.4 Summary of Neptunium-237

Neptunium-237 has never been detected in the vadose zone or perched water since monitoring began; however, there was one detection in the waste zone soil-moisture sample in April 2002. Other than three low-level, unconfirmed Np-237 detections in the aquifer in FY 2002, no detections have occurred since monitoring began in FY 1999. Tables 3-19 and 3-20 summarize the maximum Np-237 concentrations detected in vadose zone and aquifer samples since FY 1997, respectively.

Table 3-19. Summary of maximum concentrations of neptunium-237 in soil-moisture and perched water samples at the Radioactive Waste Management Complex from Fiscal Year 1997 through 2003.[a]

Sampling Range (feet below land surface)	Fiscal Year[b]	Maximum Concentration ± 1σ (pCi/L)[c]	Sample Location
Lysimeters 0 to 35 ft	1997	NA	—
	1998	NA	—
	1999	NA	—
	2000	ND	Various[d]
	2001	ND	Various
	2002	6.1±1.7	741-08-L1 (Waste Zone)
	2003	ND	Various
Lysimeters 35 to 140 ft	1997	NA	—
	1998	NA	—
	1999	NA	
	2000	ND	Various
	2001	ND	Various
	2002	ND	Various
	2003	ND	Various

Table 3-19. (continued).

Sampling Range (feet below land surface)	Fiscal Year [b]	Maximum Concentration ± 1σ (pCi/L)[c]	Sample Location
Lysimeters >140 ft	1997	NA	—
	1998	NA	—
	1999	NA	—
	2000	NA	—
	2001	NA	—
	2002	NA	—
	2003	ND	Various
Perched water wells >140 ft	1997	NA	—
	1998	NA	—
	1999	NA	—
	2000	ND	USGS-92
	2001	ND	USGS-92
	2002	ND	USGS-92
	2003	ND	USGS-92, 8802D

a. MCL = 15 pCi/L total alpha activity concentration
b. Fiscal year spans from October 1 to September (e.g., Fiscal Year 1997 is October 1, 1996, to September 30, 1997).
c. NA = not analyzed ND = not detected
d. Various locations were sampled.
MCL = maximum contaminant level
USGS = United States Geological Survey

Table 3-20. Summary of maximum concentrations of neptunium-237 in aquifer wells at the Radioactive Waste Management Complex from Fiscal Year 1997 through 2003.[a]

Fiscal Year[b]	Maximum Concentration ± 1σ (pCi/L)[c]	Well Location
1997	NA	—
1998	NA	—
1999	ND	Various[d]
2000	ND	Various
2001	ND	Various
2002	0.38 ± 0.04	A11A31
2003	ND	Various

a. MCL = 15 pCi/L total alpha activity concentration
b. Fiscal year spans from October 1 to September (e.g., Fiscal Year 1997 is October 1, 1996, to September 30, 1997).
c. NA = not analyzed ND = not detected
d. Various locations were sampled.
MCL = maximum contaminant level

3.7 Plutonium

All plutonium isotopes are anthropogenic and TRU products of nuclear reactor operations or nuclear weapons production, deployment, and testing. Approximately 1.71E+04 Ci of Pu-238 was disposed of in the SDA, primarily from INEEL reactor operations waste. Approximately 6.48E+04 Ci of Pu-239, primarily from RFP, was disposed of in the SDA. Approximately 1.71E+04 Ci of Pu-240 was disposed of in the SDA, primarily from RFP with a significant portion from INEEL reactor operations.

3.7.1 Waste Zone

Approximately 10 mL of soil moisture was collected from Waste-Zone Lysimeter 741-08-L1 on September 8, 2003, but the volume was not sufficient to analyze for plutonium; however, the sample was analyzed for gamma-emitting radionuclides with no positive detections. Historically, Pu-239/240 has been detected in soil moisture from Waste-Zone Lysimeter 741-08-L1 in November 2001 and again in April 2002.

3.7.2 Vadose Zone

3.7.2.1 Lysimeter Samples at Depths of 0 to 35 ft. Fourteen Pu-238 and Pu-239/240 analyses were performed on soil-moisture samples collected from 11 shallow lysimeters in and around the SDA in FY 2003, with no positive detections. Historical detections in shallow lysimeter samples are depicted in Figure 3-30 for Pu-238 and Figure 3-31 for Pu-239/240.

		Plutonium-238 RWMC Lysimeters (0–35 ft)															
FY	Qtr	98-1 L35	98-4 L38	98-5 L39	D15-DL07	PA01-L15	PA02-L16	PA03-L33	W05-L25	W06-L27	W08-L13	W08-L14	W09-L23	W23-L07	W23-L08	W23-L09	W25-L28
1997	1																
	2																
	3																
	4							24									
1998	1																
	2							2.2									
	3			5.6		8.5											
	4																
1999	1																
	2																
	3																
	4																
2000	1																
	2																
	3																
	4		0.88			2.3											
2001	1						3.7										
	2																
	3																
	4																
2002	1																
	2																
	3																
	4																
2003	1																
	2																
	3																
	4																

Key

plutoni

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If more than one positive detection occurred in a single quarter, then only the highest concentration is listed.
Note: RBC = 3.64 pCi/L
FY = fiscal year
RBC = 1E-05 risk-based concentration
RWMC = Radioactive Waste Management Complex

		Plutonium-239/240 RWMC Lysimeters (0–35 ft)															
FY	Qtr	98-1 L35	98-4 L38	98-5 L39	D15-DL07	PA01-L15	PA02-L16	PA03-L33	W05-L25	W06-L27	W08-L13	W08-L14	W09-L23	W23-L07	W23-L08	W23-L09	W25-L28
1997	1																
	2																
	3																
	4																
1998	1																
	2																
	3																
	4																
1999	1																
	2																
	3																
	4																
2000	1																
	2																
	3																
	4																
2001	1						0.70										
	2																
	3																
	4																
2002	1																
	2																
	3																
	4																
2003	1																
	2																
	3																
	4																

Key	
	Analysis was performed, but plutonium-239/240 was not detected.
	Plutonium-239/240 was detected (pCi/L).
	If more than one positive detection occurred in a single quarter, then only the highest concentration is listed. Note: RBC = 3.53 pCi/L FY = fiscal year RBC = 1E-05 risk-based concentration RWMC = Radioactive Waste Management Complex

Figure 3-31. Occurrences of plutonium-239/240 detections in shallow lysimeters since Fiscal Year 1997.

3.7.2.2 Lysimeter Samples at Depths of 35 to 140 ft. Twenty-eight Pu-238 and Pu-239/240 analyses were performed on soil-moisture samples collected from 12 intermediate-depth lysimeters in and around the SDA in FY 2003, with no positive detections. Historical detections are shown in Figure 3-32 for Pu-238 and Figure 3-33 for Pu-239/240.

		Plutonium-238 RWMC Lysimeters (35–140 ft)													
FY	Qtr	D06-DL01	D06-DL02	D15-DL06	I1S-DL09	I2S-DL11	I3S-DL13	I4S-DL15	I5S-DL16	O2S-DL20	O3S-DL22	O4S-DL24	O5S-DL25	O7S-DL28	TW1-DL04
1997	1														
	2														
	3														
	4	11.6	3.3	3.1											
1998	1														
	2														
	3														
	4														
1999	1														
	2														
	3														
	4														
2000	1														
	2														
	3														
	4														
2001	1														
	2														
	3														
	4														
2002	1														
	2														
	3														
	4														
2003	1														
	2														
	3														
	4														
Key		Analysis was performed, but plutonium-238 was not detected.													
		Plutonium-238 was detected (pCi/L).													
		If more than one positive detection occurred in a single quarter, then only the highest concentration is listed. Note: RBC = 3.64 pCi/L FY = fiscal year RBC = 1E-05 risk-based concentration RWMC = Radioactive Waste Management Complex													

Figure 3-32. Occurrences of plutonium-238 detections in intermediate-depth lysimeters since Fiscal Year 1997.

		Plutonium-239/240 RWMC Lysimeters (35–140 ft)													
FY	Qtr	D06-DL01	D06-DL02	D15-DL06	I1S-DL09	I2S-DL11	I3S-DL13	I4S-DL15	I5S-DL16	O2S-DL20	O3S-DL22	O4S-DL24	O5S-DL25	O7S-DL28	TW1-DL04
1997	1														
	2														
	3														
	4			1.1											
1998	1														
	2														
	3														
	4														
1999	1														0.34
	2														
	3														
	4														
2000	1														
	2														
	3														
	4														
2001	1											3.3			
	2														
	3														
	4														
2002	1														
	2														
	3														
	4														
2003	1														
	2														
	3														
	4														
Key		Analysis was performed, but plutonium-239/240 was not detected.													
		Plutonium-239/240 was detected (pCi/L).													
		If more than one positive detection occurred in a single quarter, then only the highest concentration is listed. Note: RBC = 3.53 pCi/L FY = fiscal year RBC = 1E-05 risk-based concentration RWMC = Radioactive Waste Management Complex													

Figure 3-33. Occurrences of plutonium-239/240 detections in intermediate-depth lysimeters since Fiscal Year 1997.

3.7.2.3 *Lysimeter and Perched Water Samples at Depths Greater than 140 ft.* Eighteen Pu-238 and Pu-239/240 analyses were performed on samples collected from six lysimeter and two perched water wells in and around the SDA in FY 2003, with no positive detections. Historical detections are shown in Figure 3-34 for Pu-238 and Figure 3-35 for Pu-239/240.

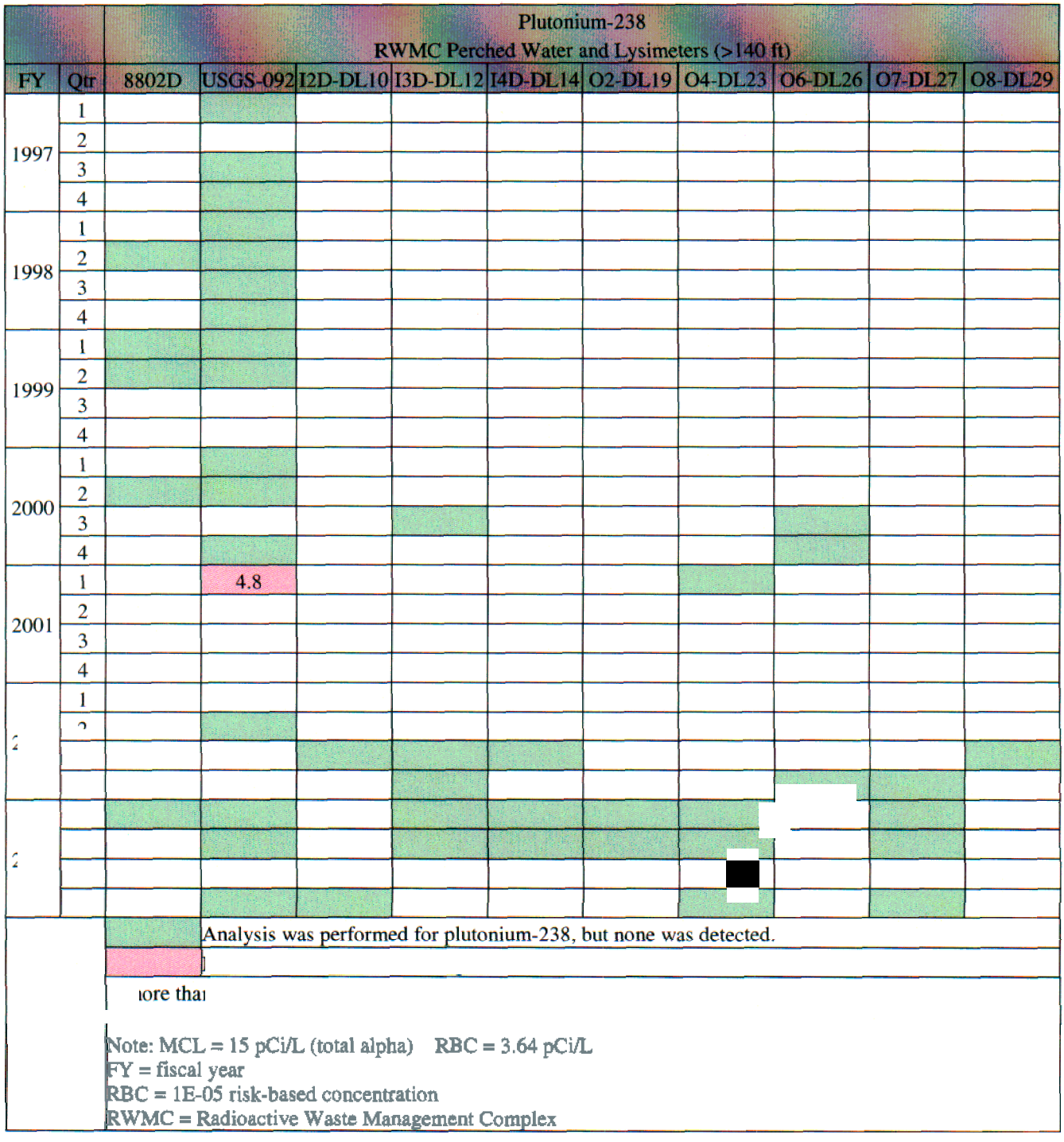

Figure 3-34. Occurrences of plutonium-238 detections in deep lysimeters since Fiscal Year 1997.

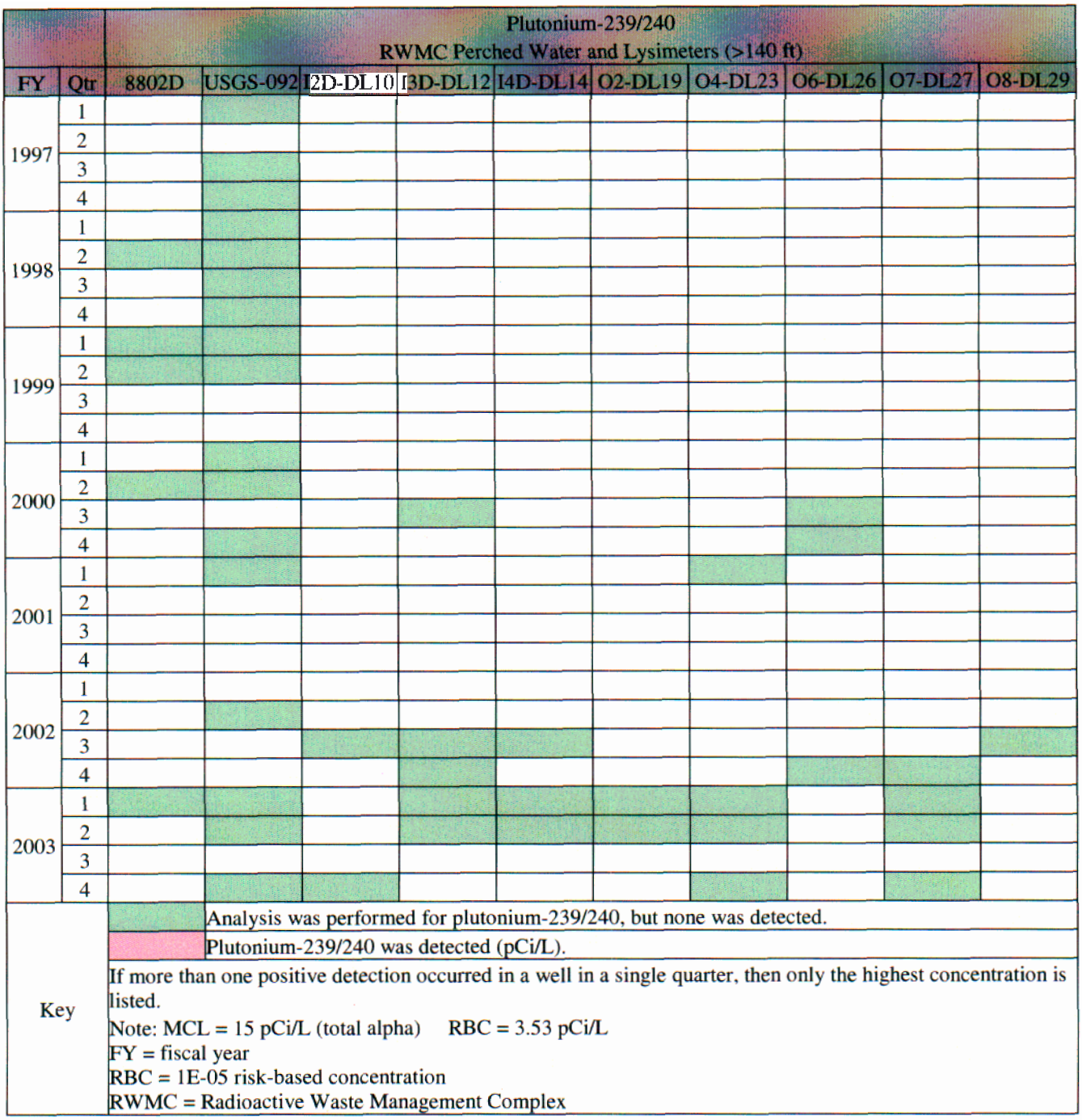

Figure 3-35. Occurrences of plutonium-239/240 detections in deep lysimeters since Fiscal Year 1997.

3.7.3 Aquifer

Sixty-three Pu-238 and Pu-239 analyses were performed on aquifer samples collected from 15 monitoring wells in the vicinity of the RWMC in FY 2003, with no positive detections. Occurrences of Pu-238 and Pu-239/240 in aquifer samples since FY 1997 are depicted in Figures 3-36 and 3-37, respectively.